Appendix C — System Engineering Technical Reviews and Associated Checklists

C1.0 Introduction

This appendix and associated Risk checklists are used to support implementation of the System Engineering (SE) Technical Reviews specified in subsection 4.2.6 of Integrated Technical Planning (Section 4.2). This appendix contains sections on 10 individual SE Technical Reviews and the technical elements of two supporting reviews. These sections describe the purpose, entry criteria, planning, timing, conduct, exit criteria, and completion of each type of SE Technical Review. For the purposes of this appendix, the lifecycle phases of the Acquisition Management System (AMS) and their related reviews/audits are based on the November 2005 AMS policy.

The SE Technical Reviews (or milestones) in subsection 4.2.6 are integral parts of the FAA SE process and lifecycle management. Figure 3.3-1 shows the relationship of these milestones with the acquisition phases and decision points. The Technical Reviews provide an independent assessment of the technical progress of the program and highlight areas that corrective action may need to be taken.

Tip

These reviews are **not the place for problem-solving**, but to verify that the problems are being addressed. They are a risk-reduction approach that manages the progress of the technical aspects of a system development or deployment.

The contents of this appendix are provided for guidance. The application of specific reviews and associated checklists are intended to be tailored based on program needs and experience. Tailoring or elimination of a specific SE milestone should be coordinated with the System Engineering Council (SEC) and documented in the program System Engineering Management Plan (SEMP). Programs need not conduct certain reviews based on the structure of the program and the AMS entry point. Certain reviews may be performed incrementally by configuration item, especially for complex systems. The SEC is the point of contact for the contents of this appendix and associated documentation. Up-to-date reference materials and lessons learned are available on SEVirtual. Please contact the Air Traffic Organization (ATO), Operations Planning (ATO-P) System Engineering, for more information about SEVirtual.

C2.0 System Engineering Milestones and Technical Reviews

Each technical review or audit should establish the readiness of a program to proceed to the next phase of the system's lifecycle. Typically, reviews focus on the development phases, where SE provides the largest benefit to the investment. Reviews and audits are scheduled at strategic points within the development cycle and are usually conducted in conjunction with, or in preparation for, a lifecycle phase milestone at which the decision to advance to the next phase is made. Technical reviews employ specific criteria tailored to each phase of the lifecycle. These criteria verify the extent of technical progress made toward the solution of the identified capabilities shortfall.

The FAA has a set of reviews established to support its system lifecycle model (see Figure 3.3-1). Subsection 4.2.6.2 discusses the generic use and structure of Technical Reviews, but it is recognized that this generic construct must be tailored to some extent for each review. This

appendix contains the application of the generic review model and details of specific review tailoring along with some best practice techniques and approaches.

At any given SE Technical Review, a chairperson leads the review. The review itself is conducted and approved in accordance with the provisions of the governing SEMP. SE Technical Review approval, as it relates to this appendix, is defined as the following:

1. Approval of the Request(s) For Action (RFA) generated during the review

2. The readiness of the design/development to proceed to the next technical phase of the program

3. Dissemination of the assessment of risk generated during the review

Completion of a Technical Review occurs after all RFA forms have been addressed and assessed, the status agreed upon, an updated Risk Assessment completed, and the review minutes promulgated.

C2.1 Mission Analysis Phase

Per the FAA AMS, Mission Analysis is the crucial beginning phase of the lifecycle management process. It establishes the basis for long-range strategic planning by individual Service Organizations and the FAA as a whole. It also identifies, defines, evaluates, and prioritizes alternative options for improving service delivery. Mission analysis consists of corporate-level mission analysis, service-area analysis, and concept and requirements development. Research projects often support and provide information to mission analysis. The following SE milestones are associated with the Mission Analysis phase:

- Technology Readiness Assessment (TRA)
- SE Investment Analysis Review (SIAR)

C2.2 Investment Analysis Phase

Per the FAA AMS, the Investment Analysis phase of the Acquisition lifecycle is conducted to ensure that the critical needs of the FAA are satisfied by practical and affordable solutions. Initial investment analysis rigorously evaluates alternative solutions to mission need and determines which offers the best value and most benefit to the FAA and its customers within acceptable cost and risk. Final investment analysis develops detailed plans and final requirements for the proposed investment program, including an acquisition program baseline that establishes cost, schedule, performance, benefits, and risk-management boundaries for program execution. The following SE milestones support the effort to obtain a favorable investment decision:

- Functional Baseline Review (FBR)
- System Requirements Review (SRR) — Program level

C2.3 Solution Implementation Phase

The Solution Implementation phase of the AMS begins at the final investment decision, when the JRC approves and funds an investment program, establishes its program baseline for variance tracking, and authorizes the Service Organization to proceed with full implementation. Solution implementation ends when a new service or capability is commissioned into operational use. The following SE Technical Reviews support execution of a program during Solution Implementation:

- System Requirements Review (SRR) — Contract level
- Preliminary Design Review (PDR)
- Critical Design Review (CDR)
- Verification Readiness Review (VRR)
- Functional Configuration Audit (FCA)
- Physical Configuration Audit (PCA)

C2.4 In-Service Management

Activity during In-Service management supports execution of the FAA mission of providing air traffic control and other services. This includes operating, maintaining, securing, and sustaining systems, products, services, and facilities in real time to provide the level of service required by users and customers. It also entails periodic monitoring and evaluation of fielded products and services as well as feedback of performance data into Mission and Investment Analysis as the basis for revalidating the need to sustain deployed assets or taking other action to improve service delivery. The following SE Technical Reviews support In-Service Management:

- In-Service Performance Review (ISPR)
- Technology Readiness Assessment (TRA)

C2.5 Disposal

The AMS states that "Service organizations must remove and dispose of fielded assets and services when they are no longer needed. This includes restoration of sites where obsolete products or services were deployed, government property disposal, precious metals recovery, and cannibalization of useful assets. The cost of removal and restoration is included in the Exhibit 300 Program Baseline of the *replacement program*. If there is no replacement program, the cost must be otherwise factored into the service-area operating plan. Removal and disposal includes decommissioning, dismantling, and demolishing of systems and equipment; restoring sites including environmental cleanup and disposal of hazardous materials; disposing of government property; recovering precious metals; and reusing surplus assets."

There are no SE milestones uniquely associated with the Disposal phase. The SE decision efforts are conducted during earlier phases of the lifecycle.

C3.0 FAA System Engineering Milestones and Technical Reviews

A total of 10 SE milestones are described in this section — each on its own "fact sheet." These sheets describe the purpose, timing, entry criteria, planning, conduct, exit criteria, completion of each SE milestone (also called a Technical Review), and helpful tips.

Each SE Technical Review has an associated Program Risk Assessment Checklist. These checklists should be used in conjunction with the SEMP during execution of the program. The Risk checklists are living documents, intended to be updated based on user experiences. The checklists are an effective tool for preparing for and conducting a review. Use the following criteria to complete the checklist(s):

- **Green.** The requisite criteria and/or documentation is available and of sufficient quality to conduct the review.
- **Yellow.** The requisite criteria and/or documentation is available and/or partially suitable to conduct the review.
- **Red.** The requisite criteria and/or documentation is NOT available or not sufficient to conduct the review.

C3.1 Technology Readiness Assessment (TRA)

The TRA is a multidisciplined technical review that assesses the maturity of Critical Technology Elements (CTE) being considered to address user needs and analyzes operational capabilities and environmental constraints within the Enterprise architectural framework. The TRA validates capability gaps at the NAS (or non-NAS) level to be addressed by the service units or Lines of Business (used to support service unit's initial Mission Need submission) and determines extent that new and/or novel technologies may be mature enough to be considered to address the gap. If a specific technology or its application is either new or novel, then that technology is considered a CTE. The TRA is not a risk assessment but is a systematic metrics-based tool for the ATO to identify and allow for early attention to technology maturation events. The TRA will score each identified CTE using 09 Levels of Maturity (LOM) (Table C-1) for both hardware and software.

Table C-1. LOM TML Descriptions

LOM Level	Definition	Description	Supporting Documentation
1	Basic principles observed and reported	Lowest level of technology readiness. Scientific research begins to be translated into applied research and development. Examples might include paper studies of a technology's basic properties.	• Published research that identifies the principles that underlie this technology. • References to who, where, when.
2	Technology concept and/or application formulated	Invention begins. Once basic principles are observed, practical applications can be invented. Applications are speculative, and there may be no proof or detailed analysis to support the assumptions. Examples are limited to analytic studies.	• Publications or other references that outline the application being considered and that provide analysis to support the concept.

3	Analytical and experimental critical function and/or characteristic proof of concept	Active research and development is initiated. This includes analytical studies and laboratory studies to physically validate analytical predictions of separate elements of the technology. Examples include components that are not yet integrated or representative.	• Results of laboratory tests performed to measure parameters of interest and comparison to analytical predictions for critical subsystems. • References to who, where, and when these tests and comparisons were performed.
4	Component and/or breadboard validation in laboratory environment	Basic technological components are integrated to establish that they will work together. This is relatively "low fidelity" compared to the eventual system. Examples include integration of "ad hoc" hardware in the laboratory.	• System concepts that have been considered and results from laboratory-scale breadboard(s). • References to who did this work and when. • Provide an estimate of how breadboard hardware and test results differ from the expected system goals.
5	Component and/or breadboard validation in relevant environment	Fidelity of breadboard technology increases significantly. The basic technological components are integrated with reasonably realistic supporting elements so it can be tested in a simulated environment. Examples include "high fidelity" laboratory integration of components.	• Results from testing a laboratory breadboard system are integrated with other supporting elements in a simulated operational environment. • How does the "relevant environment" differ from the expected operational environment? • How do the test results compare with expectations? • What problems, if any, were encountered? • Was the breadboard system refined to more nearly match the expected system goals?
6	System/subsystem model or prototype demonstration in a relevant environment	A representative model or prototype system, which is well beyond that of LOM 5, is tested in a relevant environment. Represents a major step up in a technology's demonstrated readiness. Examples include testing a prototype in a high-fidelity laboratory environment or in a simulated operational environment.	• Results from laboratory testing of a prototype system that is near the desired configuration in terms of performance, weight, and volume. • How did the test environment differ from the operational environment? • Who performed the tests? • How did the test compare with expectations? • What problems, if any, were encountered? • What are/were the plans, options, or actions to resolve problems before moving to the next level?

7	System prototype demonstration in an operational environment	Prototype near, or at, planned operational system. Represents a major step up from LOM 6, requiring demonstration of an actual system prototype in an operational environment such as an aircraft, vehicle, or space. Examples include testing the prototype in a test bed aircraft.	• Results from testing a prototype system in an operational environment. • Who performed the tests? • How did the test compare with expectations? • What problems, if any, were encountered? • What are/were the plans, options, or actions to resolve problems before moving to the next level?
8	Actual system completed and qualified through test and demonstration	Technology has been proven to work in its final form and under expected conditions. In almost all cases, this LOM represents the end of true system development. Examples include developmental test and evaluation of the system in its intended weapon system to determine if it meets design specifications.	• Results of testing the system in its final configuration under the expected range of environmental conditions in which it will be expected to operate. • Assessment of whether it will meet its operational requirements. • What problems, if any, were encountered? • What are/were the plans, options, or actions to resolve problems before finalizing the design?
9	Actual system proven through successful mission operations	Actual application of the technology in its final form and under mission conditions, such as those encountered in operational test and evaluation. Examples include using the system under operational mission conditions.	• Operational Test and Evaluation (OT&E) reports.

C3.1.1 Timing and Relationship to AMS

The assessment of new and/or promising technologies occurs at two distinct points in the AMS lifecycle as shown on Figure 3.3-1, Product Planning and Development Process, in Chapter 3: (1) during Mission Analysis to support a determination of those alternate technologies to be considered during Investment Analysis, and (2) during the In-Service Management phase of the AMS to determine if technology insertion is warranted to address user needs.

Related AMS products:

- Mission Need Analysis
- Standards, guidance, and tools for Service-level Mission Analysis

C3.1.2 Entrance Criteria and Inputs

These include the following:

- Enterprise Architecture
- Concept of Operations
- Concerns and Issues
- Technology
- Market Research
- Need
- Corporate Strategy and Goals
- Legacy System

C3.1.3 Tasks

(Reserved)

C3.1.4 Exit Criteria and Outputs

These include the following:

- Validated NAS Functional portion of Enterprise Architecture
- Technology opportunities
- Updated Risk Assessment
- Gap Analysis

C3.1.5 Metrics

(Reserved)

C3.1.6 Tools

- TRA Risk Reduction Checklist (see file **060517 FAA TRA Checklist V31**)

C3.2 SE Investment Analysis Review (SIAR)

The intent of the SIAR is to determine if the mission need capabilities shortfall can be fulfilled by candidate solutions (concepts and preliminary requirements), technical constraints are sufficiently understood, and risk definition is complete enough to support a Mission Need Decision. This checkpoint verifies that the identified needs, shortfalls, and technical constraints have been validated; that initial feasibility assessments have been accomplished; and that proposed solutions are consistent with the NAS Architecture or that required changes to the NAS Architecture have been identified. The technical part of this review involves reviewing the preliminary Program Requirements (pPR) for readiness to proceed to investment analysis. The SIAR also establishes an initial set of Technical Performance Parameters (TPP).

C3.2.1 Timing and Relationship to AMS

The SIAR occurs late in Mission Analysis during the Concepts and Requirements definition phase.

C3.2.2 Entrance Criteria and Inputs

These include the following:

- Preliminary Concept of Use (CONUSE)
- FAA Policy
- Standards
- Preliminary Operational Services and Environmental Description (OSED)
- Constraints
- Integrated Program Schedule
- Initial Description of Alternatives

C3.2.3 Tasks

(Reserved)

C3.2.4 Exit Criteria and Outputs

These include the following:

- Service Level Mission Need (SLMN)
- Preliminary Exhibit 300 Attachment 1 (pPR — previously the iRD)
- Final Description of Alternatives
- Lifecycle Cost Estimate
- OSED
- CONUSE

C3.2.5 Metrics

(Reserved)

C3.2.6 Tools

- SIAR Risk Reduction Checklist (see file TBD)

C3.3 Functional Baseline Review (FBR)

The FBR is a formal review to ensure that requirements have been completely and properly identified and that there is a mutual understanding between the implementing organization and stakeholders. It validates program cost, schedule, and performance to support Milestone approvals. It captures functional requirements that go with the Mission Analysis and Investment Analysis phases and establishes the functional baseline as the governing technical description, which is required before proceeding to the next AMS phase or Decision gate.

C3.3.1 Timing and Relationship to AMS

It is conducted just before the Initial Investment Decision (AMS Milestone 3).

C3.3.2 Entrance Criteria and Inputs

These include the following:

- Preliminary Exhibit 300 Attachment 1 (pRD — previously the iRD)
- Constraints
- FAA Policy
- Standards
- Integrated Master Schedule (IMS)
- Investment risks

C3.3.3 Tasks

(Reserved)

C3.3.4 Exit Criteria and Outputs

These include the following:

- Final Requirements Set — Exhibit 300 Attachment 1 (previously the fRD)
- Program Work Breakdown Structure (WBS)
- Program Statement of Work (SOW)
- Final SEMP

C3.3.5 Metrics

(Reserved)

C3.3.6 Tools

- FBR Risk Reduction Checklist (see file TBD)

C3.4 System Requirements Review (SRR)

The SRR determines whether the System Requirements Document (Type A Specification) correctly and completely represents the operational and constraint requirements defined in the fPR. This review also determines if the proposed functional architecture is consistent with the system requirements. The SRR occurs early in the development process before expenditure of any extensive design definition effort. As part of the process of determining whether the system requirements and architecture capture the mission's needs, values for all TPPs are projected based on system requirements and compared to the target values and critical limits set during investment analysis. The results of the TPM analysis become part of the output of the SRR. Additional TPPs might be added depending on requirement changes approved at the SRR. Critical performance limits might also be adjusted based on approved requirement changes.

Program level. The SRR is a formal internal FAA review to ensure that the system requirements have been completely and properly identified. It validates program cost, schedule, and performance to support Milestone approvals. It assesses the technical readiness of the program to begin implementation and establishes the Allocated baseline as the governing technical description, which is required for the next AMS Acquisition phase.

Contract level. The SRR at the contract level is a formal, system-level review conducted to ensure that system requirements have been completely and properly identified and that a mutual understanding between the government and contractor exists. It assesses the contractor's readiness to begin development.

C3.4.1 Timing and Relationship to AMS

The program SRR is conducted just before the Investment Decsion (AMS Investment Milestone 4). The contract SRR is conducted shortly after both AMS Milestone 4 and contract award (prior to the beginning of functional allocation activities) to assess the contractor's readiness to begin development.

C3.4.2 Entrance Criteria and Inputs

Access to the IMS and LCE cost estimate(s) are a prerequisite for conducting a successful SRR. Previously completed products that are required before proceeding to SRR include:

- pPR/fPR
- List of allocated TPPs and associated critical performance limits and target values
- Constraints
- IRDs (draft)
- Risk identification and mitigation plans
- Any proposed changes to the above items as a result of the work leading up to the SRR

Products that are to be submitted for review as part of the SRR include:

- System Requirements Document/Type A Specification (draft)
- System Functional Architecture (draft)

- A report on the results of the TPM analyses
- System specification, SOW, and the contract WBS (included at the contract level SRR).

C3.4.3 Tasks

The following tasks are required to successfully accomplish the SRR (independent of level):

- Define SRR objectives and scope
    - Establish success criteria, prerequisites (entry criteria), and approach to be used
    - Set the date for the SRR and activities leading up to the review
    - Create an agenda for the review
    - Identify and notify participants and stakeholders of their roles and responsibilities
- Identify the item(s) to be reviewed and the extent of review of each
- Compile the SRR-related data package. This package contains the SRR presentation material and all of the pertinent backup material.
- Distribute the SRR documentation to the stakeholder representatives and request timely review responses
- Obtain readiness approval for SRR and comments to the data package made via Review Item Discrepancy submissions
- Incorporate changes in the data package as needed
- Develop a summary of all concerns submitted and their respective answers
- Update risk management plans based on review
- Conduct SRR with the incorporated changes
- Document and publish SRR minutes
- Compile action-item and issues lists
- Track action items and issues
- Document closed action items and distribute to the SRR stakeholders

C3.4.4 Exit Criteria and Outputs

These include the following:

- Approved System Requirements Document/Type A Specification
- Approved System Functional Architecture
- Approved changes to the fPR
- Approved changes to the IRDs
- Approved changes to the TPPs
- Approved TPM report
- Updated Risk Management Plan(s)

- System Specification (includes obtaining contractor agreement at contract SRR)
- Risks for recommended alternative
- LCE cost estimate for recommended alternative
- Draft In-Service Review (ISR) Checklist
- Interface documents
- Contractor SOW

C3.4.5 Metrics

The metrics for this review consist primarily of the following:

- Customer Acclimation
- Number of system requirements that surface at later reviews compared to the original number of requirements
- Errata

If prototyping has been done to assist in finalizing the system requirements, then it would be possible to measure changes in the status of the TPPs. Otherwise, Technical Performance Measurement (TPM) would not be part of the metrics for this review.

C3.4.6 Tools

The primary tools used for this review are:

- Requirements Database
- Risk Database
- Action Item Database
- Issues Database
- TPM Database (if used as a metric)
- SRR Risk Reduction Checklist (see file TBD)

C3.5 Preliminary Design Review (PDR)

The PDR is a formal review that assesses the preliminary design against the Allocated baseline and confirms that the preliminary design logically follows the SRR findings and meets the requirements. It normally results in approval to begin detailed design. Many organizations see it as the last viable point for effective technology insertion.

The preliminary design describes the system functions allocated to the subsystem and configuration item level. The solution design definition lacks considerable detail and is represented by the functional, performance, and interface requirements included in the Type B and Type C Specifications, and the draft Interface Control Documents (ICD). The PDR demonstrates that the preliminary design meets system and program requirements as specified in the Type A Specification previously approved. As part of the process of determining whether the design meets requirements, values for all TPPs allocated to the design are projected and compared with the target values and critical limits set during investment analysis. The results of the TPM analysis become part of the output of the PDR. Additional TPPs might be added depending on design or requirement changes approved at the PDR. Critical performance limits might also be adjusted based on approved requirement changes.

C3.5.1 Timing and Relationship to AMS

The PDR is conducted at completion of functional allocation activities by the contractor and prior to the beginning of detailed design. (See Figure 3.3-1, Product Planning and Development Process, in Chapter 3.)

C3.5.2 Entrance Criteria and Inputs

The completed Allocated baseline as documented in design specifications for each hardware and software configuration item is the basis for conducting the review. Products previously completed by the contractor or provided as part of the contract that are required before proceeding to PDR include:

- List of allocated TPPs and associated critical performance limits and target values
- Constraints
- Type A Specification
- Functional Architecture
- IRDs
- Risk identification and mitigation plans
- Any proposed changes to the above items as a result of the work leading up to the PDR

Products that are to be submitted for review as part of the PDR include:

- Type B Specification (draft)
- Type C Specification, if needed (draft)
- Requirements Allocation Matrix (draft)

- ICDs (draft)
- Report on the results of the TPM analyses
- Preliminary design documentation (conceptual layouts, etc.)

C3.5.3 Tasks

The following tasks are required to successfully accomplish the PDR:

- Define PDR objectives and scope
  - Establish success criteria and prerequisites (entry criteria, and approach to be used)
  - Set the date for the PDR and activities leading up to the review
  - Create an agenda for the review
  - Identify and notify participants and stakeholders of their roles and responsibilities.
- Identify the item(s) to be reviewed and the extent of review of each
- Compile the PDR-related data package. This package contains the PDR presentation material and all of the pertinent backup material.
- Distribute the PDR documentation to the stakeholder representatives and request timely review responses
- Obtain readiness approval for PDR and comments to the data package made via Review Item Discrepancy submissions
- Incorporate changes in the data package as needed
- Develop a summary of all concerns submitted and their respective answers
- Update risk mitigation plans based on review
- Conduct PDR with the incorporated changes
- Document and publish PDR minutes
- Compile action item and issues lists
- Track action items and issues
- Document closed action items and distribute to the PDR stakeholders

C3.5.4 Exit Criteria and Outputs

Successful completion of PDR results in the approval to begin detail design and includes the following outputs:

- Updated Risk Mitigation plans to include risks identified during PDR
- RFA(s) with approved action plans
- Approved allocated baseline
  - Preliminary Type B Specification
  - Preliminary Type C Specification
  - Requirements Allocation Matrix

  - Preliminary ICDs
- Approved changes to the Type A Specification
- Approved changes to the functional architecture
- Approved changes to the IRDs
- Approved TPM report and approved changes to the TPPs
- Resolution of any contract scope issues revealed during the PDR process

C3.5.5 Metrics

The PDR metrics are:

- Customer Acclimation
- The number of new subsystem requirements that surfaces at later reviews or testing compared to the initial number of requirements
- The number of design features that changes, compared to the original number, as a result of inadequate analysis prior to the PDR
- The number of RFAs accepted with formal action plans

The status of the TPPs is also used as a metric to measure the progress of the program.

C3.5.6 Tools

The primary tools used for this review are:

- PDR Risk Reduction Checklist (see file TBD)
- Requirements Database
- Risk Database
- Action Item and Issues Database
- TPM Database

C3.6 Critical Design Review (CDR)

The CDR is a formal review conducted to evaluate the completeness of the design, its interfaces, and suitability to start initial manufacturing. The CDR evaluates the design of a system or Configuration Item (CI) down to the lowest design level. It assesses the preliminary system product design package against the Allocated baseline and is conducted during the design and development phase of a program when detail design is essentially complete. The review:

- Determines that the detail design of the system or CI under review satisfies the performance and engineering specialty requirements of the Preliminary Hardware Product Specifications or Hardware Configuration Item (HWCI) development specifications. This includes projecting values for all TPPs allocated to the design and comparing them to the target values and critical limits previously set. The results of the TPM analysis become part of the CDR output.
- Establishes the detail design compatibility between the configuration items and other items of equipment, facilities, computer software, and personnel.
- Assesses system or CI risk areas (on a technical, cost, and schedule basis).
- Assesses the results of the producibility analyses conducted on system hardware.
- Reviews the preliminary hardware and/or software product specifications. For Computer Software Configuration Items (CSCI), this review focuses on determining the acceptability of the detailed design, performance, and test characteristics of the design solution and on the adequacy of the operation and support documents.

C3.6.1 Timing and Relationship to AMS

Figure 3.3-1 (see Chapter 3) shows the CDR occurring during Solution Implementation at completion of CI detail design activities and prior to fabrication of hardware and/or coding of final software modules (typically the "90 percent" design point).

C3.6.2 Entrance Criteria and Inputs

Products previously completed by the contractor or provided as part of the contract that are required before proceeding to CDR include:

- Allocated Baseline (i.e., Type A Specification, IRDs, functional architecture, etc.)
- List of allocated TPPs and associated critical performance limits and target values
- Constraints
- CDR Planning documentation
- Master Verification Plan
- Risk identification and mitigation plans
- Previous review(s) RFAs and action items
- Any proposed changes to the above items as a result of the work leading up to the CDR

Products that are to be submitted for review as part of the CDR include:

- Detailed Type B and Type C Specifications
- Detailed Requirements Allocation Matrix
- Detailed ICDs
- Subsystem Functional Architecture
- Completed design package for each hardware and software CI (assembly layouts, etc.) with supporting design documentation
- Draft test plans
- Report on results of the TPM analyses
- Requirements Compliance Matrix for each CI

C3.6.3 Tasks

The following tasks are required to accomplish a successful CDR:

- Define CDR objectives and scope
    - Establish success criteria and prerequisites (entry criteria and approach to be used)
    - Set the date for the CDR and activities leading up to the review
    - Create an agenda for the review
    - Identify and notify participants and stakeholders of their roles and responsibilities
    - Identify the item(s) to be reviewed and the extent of review of each
- Compile the CDR-related data package. This package contains the CDR presentation material and all of the pertinent backup material.
- Distribute the CDR documentation to the stakeholders and request timely review responses
- Obtain readiness approval for CDR and comments to the data package made via Review Item Discrepancy submissions
- Incorporate changes in the data package as needed
- Develop a summary of all concerns submitted and their respective answers
- Update risk mitigation plans based on review
- Conduct CDR with the incorporated changes
- Document results of CDR and publish CDR minutes
- Compile action-item list
- Track approved action items
- Document closed action items and distribute to the CDR stakeholders

C3.6.4 Exit Criteria and Outputs

Successful completetion of the CDR results in customer concurrence that the detailed design satisfies the system functional and performance requirements and is ready to begin fabrication. The CDR outputs or exit criteria are:

- RFA(s) with approved action plans
- Approved changes to Allocated baseline elements
- Approved TPM report
- Updated Risk Mitigation Plans to include risks identified during CDR
- Resolution of any contract scope issues revealed during the CDR process

C3.6.5 Metrics

The CDR metrics are:

- Customer (Stakeholder) Acclimation, which is defined as the extent of satisfaction in the results of the CDR meeting the stated objectives. This can be measured through interviews and/or feedback forms for each presentation made during each review (incremental as well as final).
- The percentage of CDR-required data available on schedule. In the case of a technical review involving a supplier, this can be measured as the percent of review-related CDRLs submitted on schedule.
- The number of new subsystem requirements that surfaces at later reviews or testing compared with the initial number of requirements. A variation is to measure the number of scope issues that result in some contractual action.
- The number of RFAs accepted with formal action plans

The status of the TPPs is also used as a metric to measure the progress of the program.

C3.6.6 Tools

The primary tools used for this review are:

- CDR Risk Reduction Checklist (see file **060522 FAA CDR Checklist v3.1**)
- Requirements Database
- Risk Database
- Action Item and Issues Database
- TPM Database

C3.7 Verification Readiness Review (VRR)

The Verification Readiness Review is a formal review of the contractors' readiness to begin product technical evaluation (i.e., verification including testing) on both hardware and software configuration items.

C3.7.1 Timing and Relationship to AMS

The VRR is conducted at completion of system fabrication and prior to initiation of formal verification activities (see Figure 3.3-1 Solution Implementation — Verification).

C3.7.2 Entrance Criteria and Inputs

These include the following:

- System definition is under formal configuration control
- All verification plans are approved.
- Draft verification procedures are available.
- Verification assets/resources are identified and available.

C3.7.3 Tasks

Please refer to subsection 4.12.2.5.2.2.6 (in Section 4.12, Validation and Verification) for task details.

C3.7.4 Exit Criteria and Outputs

Successful completion of the VRR results in approval to begin formal verification. The outputs include the following:

- Updated Risk Mitigation Plans to include risks identified during VRR
- Detailed verification procedures

C3.7.5 Metrics

(Reserved)

C3.7.6 Tools

- VRR Risk Reduction Checklist (see file TBD)

C3.8 Functional Configuration Audit (FCA)

FCA is a formal review to verify that the as-built system and all subsystems can perform all their required design functions in accordance with their functional and allocated configuration baselines. (Figure C-1 below describes the FCA process.) FCA supports completion of the PCA.

The FCA documents stakeholder approval of verification that a CI's actual performance fulfills the functional and performance requirements established in the system functional baseline. An FCA is held for each new configuration item or group of related configuration items. An FCA can also be held during the In-Service phase of a system's lifecycle to verify modifications and upgrades to a CI, or product and process improvements. The entry and exit criteria for this audit are to be included in the SEMP. An FCA is an incremental part of the system verification process. System changes that involve multiple CIs may require multiple audits. A final audit, or system verification review, is held to verify that all planned audits for a particular development have been successfully completed. Since the FCA relies on testing to determine if the CI meets all specified requirements, such testing is a prerequisite for the FCA. Figure C-1 contains the process-based management chart for FCA.

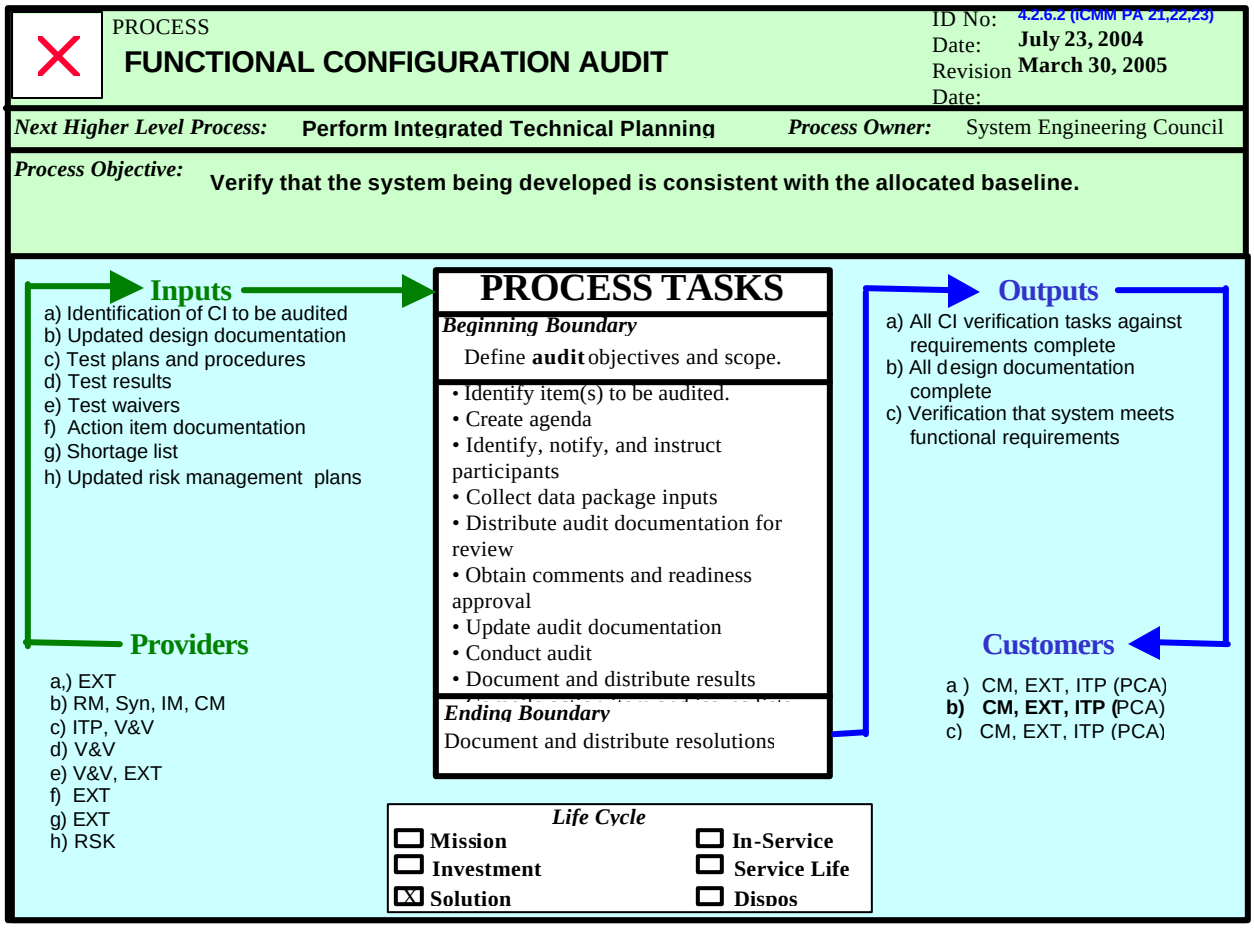

Figure C-1. Functional Configuration Audit Process

C3.8.1 Timing and Relationship to AMS

The FCA is conducted at completion of qualification and integration testing and prior to delivery of first production article.

C3.8.2 Entrance Criteria and Inputs

These include the following:

- Verification program is complete.
- Verification reports are approved.
- Verification article configuration compliance to design package is established.

Basic inputs to the FCA include:

- Identification of the CI to be audited
- Update of all specification and design documentation complete (Specification Types A, B, and C; Requirements Allocation Matrix; ICDs; System Concept of Operations (CONOPS); Subsystem Functional Architecture; Physical Architecture; and CI Description)
- All manufacturing process requirements and documentation finalized (Specification Types D and E)
- Test plans and procedures
- Test results
- A list of all deviations/waivers against the CI, either requested or customer approved
- A list of all action items for corrective action resulting from the test results
- Documentation of proposed corrective actions
- Complete shortage list
- Updated risk mitigation plans based on the test results

C3.8.3 Tasks

The following tasks are required to successfully accomplish an FCA:

- Define FCA objectives and scope
    - Establish success criteria and prerequisites (entry criteria, and approach to be used)
    - Set the date for the FCA and activities leading up to the audit
    - Create an agenda for the audit
    - Identify, notify, and instruct participants and stakeholders concerning their roles and responsibilities
    - Identify the CI(s) to be audited and the extent of review of each
- Collect data package inputs for FCA briefing and documentation

- Distribute FCA documentation to stakeholder representatives for review for completeness, correctness, clarity, and organization
- Obtain readiness approval for FCA and comments to the data package made via audit worksheets
- Update FCA documentation per the worksheets
- Conduct FCA
    - Report on verification status — requirements verified versus planned corrective actions
    - Report on completeness of all development and design documentation, including planned revisions associated with corrective actions
    - Report on key issues identified in the review of the FCA documentation
    - Report on risk assessments and mitigation plans
    - Assign responsibility for corrective actions and documentation revisions
    - Obtain stakeholder approval to proceed
- Document and distribute the results of the FCA
- Compile action-item and issues list
- Track action items and issues
- Document and distribute the resolutions of action items and issues

C3.8.4 Exit Criteria and Outputs

The key outcome of the FCA is to determine if there is any gap of required versus verified performance. The key FCA outputs are:

- Verification that the system meets functional requirements
    - Type A Specification verified
- Completion of all CI verification tasks against requirements
    - Type B Specification verified
    - Type C Specification verified
    - Requirements Allocation Matrix verified
    - ICDs verified
    - (Any) Gap of required versus verified performance documented
- Completion of all development and design documentation
    - Type A, B, and C Specifications
    - Requirements Allocation Matrix
    - ICDs
    - System Level CONOPS
    - OSED
    - Functional architecture
    - Physical architecture
    - CI Description, including a Configuration reconciliation list between the articles in the verification program and the configuration defined by the design package

C3.8.5 Metrics

The metric is customer approval of FCA and the number of open worksheets generated if the approval is conditional.

C3.8.6 Tools

The primary tools for this audit would be:

- FCA Risk Reduction Checklist (see file TBD)
- Requirements Database
- Action Item Database
- Issues Database

C3.9 Physical Configuration Audit (PCA)

The PCA is a formal audit that establishes the Product Baseline for formal configuration control of the CI for Production and later Lifecycle phases. It assesses the as-delivered system's compliance with the product design and manufacturing documentation. Successful completion of the PCA marks the complete transfer of formal configuration control from the developer to the product owner.

The PCA is typically performed on an early production configuration item. The actual effectivity established for the PCA centers around the transfer of risk. Because formal configuration control occurs at this point, the issue of liability for changes becomes the issue. It is in the interest of the system owner to hold the audit as late as possible; the developer is looking to transfer the risk of changes to the owner as early as possible. Setting the actual effectivity often becomes a contractual or scope issue.

The PCA documents the agreement of the stakeholders that the CIs actual configuration as built by the specified manufacturing processes conforms to the Technical Data Package that describes the CI baseline. The audit also ensures that the proper processes and procedures are in place to confirm the following:

- The CI design definition and planning are current.
- Hardware/software conforms to the design package and requirements, and that differences have been reconciled.
- Nonconformities have been reconciled in accordance with applicable procedures.
- The manufacturer has accomplished specified production tests.
- Part numbers and nomenclature of the CI are consistent with drawings and parts lists, and item nomenclature agrees with the approved nomenclature.
- Any configuration differences between the PCA unit and formal verification units have been identified, documented, and properly authorized for incorporation.
- The initial product baseline includes all authorized changes, current complete design and production packages, ICDs, and Acceptance Test procedures.

A PCA is held for each new configuration item or group of related configuration items. A PCA can also be held during the in-service phase of a system's lifecycle to verify modifications and upgrades to a CI or product and process improvements. The entry and exit criteria for this audit and any other pertinent accomplishment and associated success criteria are to be included in the SEMP. System changes that involve multiple configuration items may require multiple audits. A final audit is held to verify that all planned audits for a particular development have been successfully completed.

C3.9.1 Timing and Relationship to AMS

The PCA is conducted after delivery of initial production unit and prior to Contractor Acceptance and Inspection.

C3.9.2 Entrance Criteria and Inputs

To conduct a successful PCA, two other control functions must have occurred: completion of theIndependent Operational Test and Evaluation (IOT&E) and completion of the FCA.

Basic inputs to the PCA include:

- Identification of the CI to be audited
- Completion of the technical data package
  - Update of all specification and design documentation complete (Specification Types A, B, and C; Requirements Allocation Matrix; ICDs; System CONOPS; Subsystem Functional Architecture; Physical Architecture; and CI Description)
  - Incorporate all required changes identified through the IOT&E
- Manufacturing and quality control plans complete and quality control results available
  - Update of all manufacturing process requirements and documentation completed (including Specification Types D and E)
- Configuration differences between FCA and PCA units reconciled
  - A list of all deviations/waivers against the CI, either requested or customer approved
- Complete shortage list
- Updated risk mitigation plans based on the FCA results

C3.9.3 Tasks

The process-based management chart for the PCA (Figure C-2) and addresses the following tasks:

- Define the objectives and scope of the PCA
  - Establish success criteria and prerequisites (entry criteria, and approach to be used)
  - Set the date(s) for the PCA and activities leading up to the audit
  - Create an agenda for the audit
  - Identify and notify participants and stakeholders of their roles and responsibilities
  - Identify the CI(s) to be audited and the extent of review of each
- Review status of action items from the FCA to determine if they have been adequately resolved; identify any corrective action required
- Verify that all changes identified through the IOT&E have been incorporated; identify any corrective action required. Reconcile all proposed and actual configuration differences with the approved Product Baseline
- Conduct physical review of the CI and compare the configuration to the proposed baseline documentation; identify any corrective action required

Audits are typically performed at the facilities where the items or their selected subassemblies are produced. The producer shall ensure that suitable facilities and support are available. The PCA Plan should specify the items to be audited and their respective schedules.

Tip The most common approach is to conduct a product audit where the selected item(s) is physically compared with its documentation. This approach is usually accomplished incrementally for complex systems by conducting individual audits on selected subassemblies and components leading to a final review at the system level. The items audited should be designated by serial number before their induction into the manufacturing process to minimize the amount of potentially destructive teardown or disassembly.

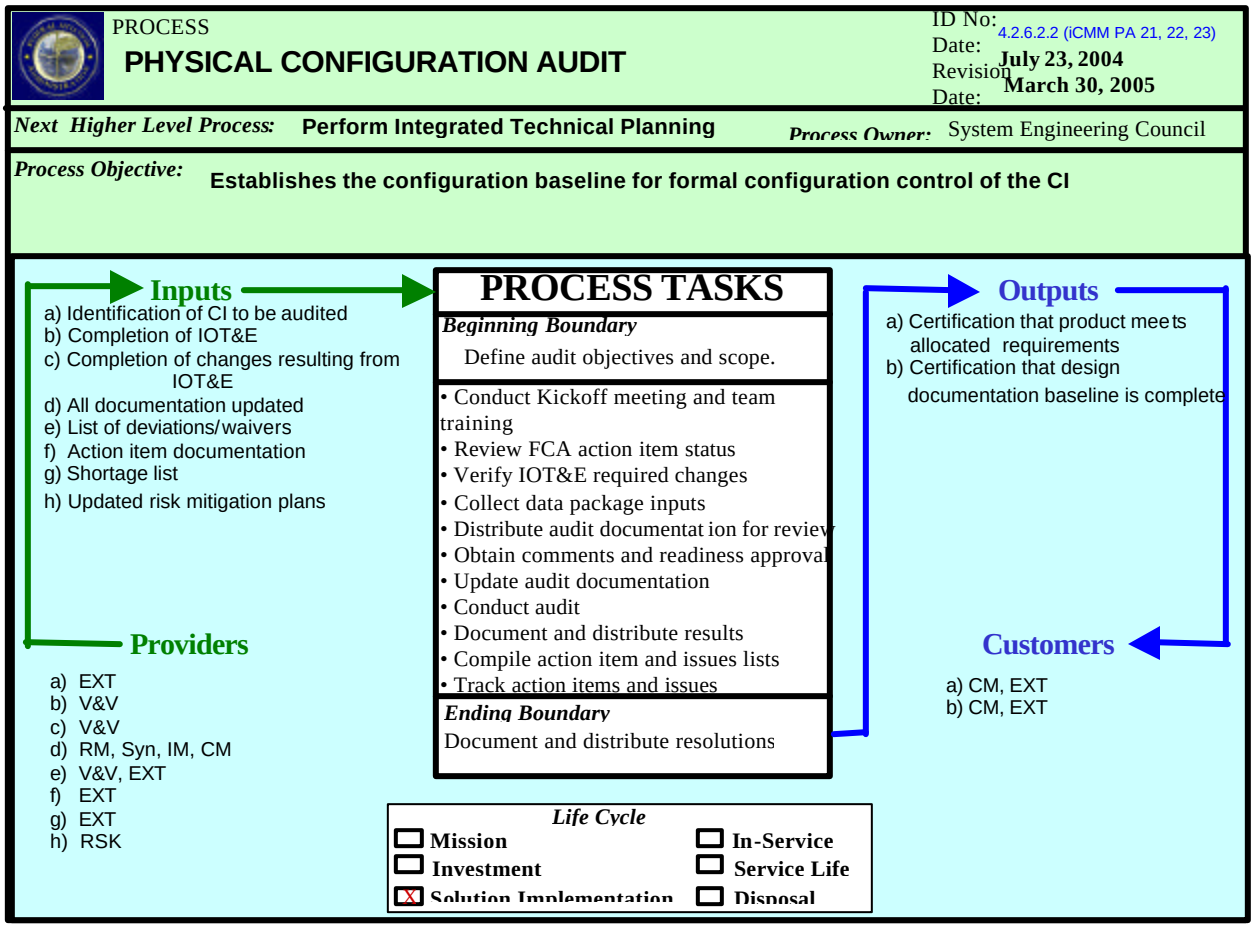

Figure C- 2. Physical Configuration Audit Process

Tip For organizations that are ISO compliant, a process audit approach can be considered. The approach builds on the ISO process of periodic compliance sampling by identifying and determining if key processes are in place and compliant with the organization's ISO certification. To confirm the integrity of this approach, it is recommended that a single item be selected, and a one-time verification of its major processes be accomplished. To be successful, this verification must conclude that the item physically conforms to its design documentation and that all of its documentation in the process flow is adequate to support production and configuration control of that item.

The process audit approach includes the following tasks:

- Collect data package inputs for PCA briefing and documentation
- Distribute PCA documentation to stakeholder representatives for review for completeness, correctness, clarity, and organization
- Obtain readiness approval for the PCA and comments to the data package made via PCA worksheets
- Update PCA documentation per the worksheets
- Conduct the PCA
  - Report on change status — changes incorporated versus planned corrective actions
  - Report on completeness of all development and design documentation, including planned revisions associated with corrective actions
  - Report on verification of consistency between CI and documentation, including planned corrective actions
  - Report on key issues identified in the review of the PCA documentation
  - Report on risk assessments and mitigation plans
  - Assign responsibility for corrective actions and documentation revisions
  - Obtain stakeholder approval to proceed
- Document and distribute the results of the PCA
- Compile action item and issues lists
- Track action items and issues via PCA worksheets
- Document and distribute the resolutions of action items and issues

C3.9.4 Exit Criteria and Outputs

The result of a successful PCA is the issuance of a signed PCA Certificate. This signifies that the system has demonstrated compliance with its design package and that formal configuration control is ready to be transferred from the implementer to the owner of the item or system. The PCA is complete when the Certificate is "unconditional"; that is, issued without any open action items or noncompliances. If there are open action items or noncompliances (documented, tracked, and resolved via PCA worksheets), these are annotated on the PCA Certificate, and the certification is considered "Conditional." Its status is changed to "unconditional" after all worksheet action plans are completed and accepted by the certifying party. The key outputs of the PCA are the following:

- Certification that product meets allocated requirements
  - Types A, B, and C Specifications verified
  - Requirements Allocation Matrix verified
  - ICDs verified
- Completion of all development and design documentation
  - Type A, B, and C Specifications
  - Requirements Allocation Matrix
  - ICDs
  - System Level CONOPS

- OSED
- Functional architecture
- Physical architecture
- CI Description
- User manuals

C3.9.5 Metrics

The primary metric is the Customer's issuance of a PCA Certificate signifying unconditional completion of this milestone. Interim metrics include the number of worksheets generated/open (conditional completion) and/or the number of incremental PCAs completed (if an incremental approach is used).

C3.9.6 Tools

The primary tools used for this audit are:

- PCA Risk Reduction Checklist (see file TBD)
- Requirements Database
- Action Item Database
- Issues Database

C3.10 In-Service Performance Review (ISPR)

The ISPR is a formal technical review to characterize In-Service technical and operational health of the deployed system by providing an assessment of risk, readiness, technical status, and trends in a measurable form that will substantiate In-Service support and budget priorities. It is intended to evaluate performance against baseline values and customer expectations. Post-implementation review(s) at deployment sites help to determine whether performance and benefits in the Exhibit 300 Program Baseline are being achieved. When projections are not being realized, corrective action is planned and implemented. Periodic operational evaluations of fielded assets continue throughout In-Service Management to identify performance shortfalls, determine trends in the cost of ownership, and identify adverse support trends. These evaluations are the basis for revalidating the merit of sustaining investment assets or the need for other action. Findings are fed back into service analysis, where it is determined whether to continue to sustain existing assets or recommend new investments to solve systemic operational problems in the service environment.

C3.10.1 Timing and Relationship to AMS

The In-Service Management phase begins when the new system, software, facility, or service goes into operational use and continues for as long as the product is in use. This phase is characterized by a continuing partnership among the providing, operating, and support organizations. This review is typically held a minimum of 2 years after introduction of the new capability into the operational NAS environment.

C3.10.2 Entrance Criteria and Inputs

(Reserved)

C3.10.3 Tasks

(Reserved)

C3.10.4 Exit Criteria and Outputs

The outcome of this review is a decision on whether a configuration item (or system) has reached the end of its useful life or is no longer satisfying an identified need. The outcome may span a range of recommendations—from a strategy of continued support of the installed capability to a decision to obsolete the existing system and enter the Mission Analysis phase to address the resulting predicted need shortfall. (See Section 4.13, Lifecycle Engineering, for further discussion of this outcome.)

C3.10.5 Metrics

(Reserved)

C3.10.6 Tools

The primary tools used for this audit are:

- The PCA Risk Reduction Checklist (see file TBD)

C4.0 FAA System Engineering Inputs to Related Reviews

Each SE control gate or milestone fits within the AMS framework and supports various investment decisions as shown in Table 4.2-4 (SE Milestones as a Function of AMS Lifecycle Phases (based on Nov 2005 AMS)) in Section 4.2. The entry and exit criteria for both the SE milestones and AMS investment decision points are addressed to provide the reader visibility into the extent of overlap between the two needs.

C4.1 Investment Analysis Readiness Review (IARR)

(Reserved)

C4.2 Integrated Baseline Review (IBR)

(Reserved)

C4.3 In-Service Review (ISR)

(Reserved)

C5.0 Request for Action (RFA) Forms and Process

(Reserved)